Automated Neural Flight Control Test (ANCT) Software

What it is: The Automated Neural Flight Controller Test (ANCT) tool was designed to help engineers analyze complex control systems and assist with the validation and verification task by helping the engineer conduct, manage and analyze the outputs of test experiments in a simulation environment.

Features: ANCT was specifically designed to help test engineers validate flight controllers in various flight conditions, quantify performance, and determine regions of stability. ANCT was developed in the MATLAB environment and by taking advantage of MATLAB toolboxes, ANCT expands MATLAB to analyze controller models with an assortment of new analysis tools. ANCT can be used to verify and validate Matlab/Simulink models. ANCT is designed to analyze a Simulink model by simulating the model using all possible combinations of the model inputs. By introducing random numbers into the test inputs, the user can perform Monte Carlo simulation to estimate the sets of model parameters and inputs that correspond to the system responses of interest. In each test case, ANCT simulates the model by using the inputs from a Test Case Matrix, and evaluates the time-series outputs during a specified time or condition window by using the output evaluation functions. This process yields the Performance score that represents the degree to which an output violates user-defined criteria or failure criteria. ANCT introduces the single measurement score, called the Test score, a function of the Performance scores of the various system outputs. The Test score provides a single measurement of the system response in each test case. ANCT uses both a MATLAB MAT-file and a MySQL database to store the test setup information and the test results data. ANCT has three main groups of graphical user interfaces: 1) Test Generation Interface, 2) Simulation Parameters Setup User Interface, and 3) Test Result Manager Interface. The ANCT Genetic Algorithm Analysis tool provides a new approach to numerically analyze controller models faster than with stochastic simulation methods such as Monte Carlo Simulation.

Benefits: Verification and validation of control systems over the entire operating envelope and under specified fault conditions is a difficult and challenging task. ANCT provides a unique set of software tools integrated into the MATLAB environment along with a MySQL database to store all the test results and make it easy for an engineer to use.

Successes: ANCT has been used for verification and validation of control systems in a number of demonstration applications, including the Intelligent Flight Control Systems F-15 and C-17 Projects adaptive neural flight control systems at NASA Dryden Flight Research Center, Edwards, CA. The utilization of this tool for Lyapunov error bound identification in neural flight controllers where the adaptation law in the controller is derived using Lyapunov stability techniques is being studied.

Contexts in which it is best used: ANCT is expected to be an important software tool in support of the overall design, verification and validation tasks for complex control systems.

Compare with alternative known products or technologies. To the best of our knowledge, there is no competing tool that is available.

What will a successful collaboration look like?

a. **What will you as the technology provider do?** We will discuss with the project to see if ANCT is a good fit. We will help the user put together a proposal to use the ANCT tool. Learning the ANCT tool will require approximately a one day one-on-one session with the user. Support from the ANCT team will be provided by Fola Soares and Ken Loparo. Telephone and/or e-mail support will be available.
b. **What should the development team do?** Transition the technology to NASA V&V applications. Write a proposal to use the ANCT tool on the user's project and demonstrate ANCT tool using the user's project.
c. **How will you, as technology provider, work together with the development team to ensure a successful collaboration?** See item a above and otherwise we will support the technology transfer initiative in any way that is appropriate.

For information, contact:

Fola Soares (Primary Point of Contact)
Contek Research, Inc.
Tel: 310-414-6720, e-mail: fola@contekresearch.com
At NASA DFRC: tel: 661-276-5536, email: fola.soares@dfrc.nasa.gov

Kenneth A. Loparo
EECS Department
Case Western Reserve University
Cleveland, Ohio 44106-7071
phone: 216-368-4115
fax: 216-368-3123
email: kal4@cwru.edu